Thesis/
Reports
Ulrich,
R. S.

PSYCHOPHYSIOLOGICAL INDICATORS OF LEISURE BENEFITS

R. S. Ulrich, U. Dimberg & B. L. Driver

Library

PSYCHOPHYSIOLOGICAL INDICATORS OF LEISURE BENEFITS

by

Roger S. Ulrich
Texas A&M University

Ulf Dimberg
Uppsala University, Sweden

B. L. Driver
Rocky Mountain Forest and Range
Experiment Station, U.S. Forest Service

Final report for Cooperative Agreement 28-C7-424

Aug. 18, 1989

INTRODUCTION

Different authors prefer to distinguish between the concepts "leisure," "recreation," and "play," but for the purposes of this paper such distinctions are not necessary. Specifically, our main objectives include examining (1) the use of psychophysiological methods for investigating beneficial consequences of leisure; (2) the role of leisure activities and leisure environments, particularly natural environments, in helping people cope with various types of stressors; and (3) the possibilities and challenges for future research. In a nutshell, our primary interest is the application of psychophysiological approaches to the issue of restorative properties of leisure activities and settings--how they facilitate coping with everyday strains and stresses. "Psychophysiological" refers to research approaches that are concerned with the measurement of physiological responses as they relate to human emotions, cognition, and behavior.

Physiological measures are being used increasingly in leisure research to investigate important health related benefits derived from physical exercise, such as improved cardiovascular performance (see chapters in this volume by Froelicher and Froelicher, and Paffenbarger). Apart from exercise benefits, physiological methods have great promise for contributing to the identification and measurement of positive consequences of passive leisure experiences, such as recovery from stress. More generally, physiological measures can be used effectively to assess important beneficial effects on well-being that are not tied directly to physical exertion. Most of the discussion in this paper is concerned with psychophysiological approaches

for investigating restorative benefits--not related directly to exercise--of leisure experiences in natural environments.

The next section overviews physiological measures used in psychophysiology that potentially can be applied in investigating a wide range of responses and beneficial effects associated with leisure experiences. Examples of psychophysiological findings are discussed that relate to leisure and recreation issues. Capabilities, advantages, and limitations of psychophysiological methods are described from the standpoint of leisure research. The discussion then shifts to stress reducing benefits of leisure encounters with natural environments. Conceptual notions regarding stress are discussed, and findings from verbally based approaches, and then psychophysiological methods, are surveyed that relate to restorative influences of nature. Subsequent sections outline a design for a possible future study using physiological measures, and describe research needs and challenges.

PHYSIOLOGICAL MEASURES

For decades, physiological measures have been used extensively as indicators of human responses to emotional, stressful, and arousal increasing stimulation. In psychophysiology, physiological activity is typically detected from aspects or levels of four major bodily response systems: (1) the electrocortical, (2) autonomic, (3) skeleto-muscular, and (4) endocrine. Measurements of activity in the first three bodily systems are usually made with skin surface electrodes, whereas endocrine excretions are assessed using biochemical methods. Important indicators of electrocortical activity are the rhythmic brain potentials (e.g., alpha waves, beta waves), called the

electroencephalogram (EEG), and cortical evoked potentials. Major autonomic response parameters include cardiovascular activity (e.g., heart rate, blood pressure, blood volume), and sweat gland activity which typically is measured as electrical skin conductance in the hands. Responses from the muscular system, such as muscle tension, can be measured by recording electromyographic (EMG) activity with skin electrodes attached over specific muscle regions. Assessment of endocrine activity involves biochemical measurement of various stress hormones, such as epinephrine and norepinephrine levels in blood and urine samples.

In general, these various physiological measures have been used to indicate different degrees of attention, arousal, and stress related reactions, as well as cognitive processing and specific emotional states. For instance, a stress response in contrast to relaxation is associated with increased physiological activity evident in autonomic responses such as heart rate, blood pressure, and skin conductance, as well as with muscle tension and blocking of alpha EEG activity. There is considerable evidence that different emotional reactions or states--which constitute an important component of human well-being--are associated with differential bodily reactions. For instance, a stimulus that elicits feelings of fear usually induces a physiological reaction of increased heart rate and skin conductance activity. General categories of stimuli that elicit bodily responses include social stimuli, task-related stimuli, cognitive/internal stimuli, and visual or auditory environmental stimuli (e.g., Grings and Dawson, 1978). As an example of responsiveness to simple environmental stimuli, a low intensity auditory stimulus such as a soft tone evokes a momentary cluster of physiological reactions (e.g., short-term or phasic heart rate deceleration and increased skin conductance) that is called an "orienting" response-- which typically diminishes or habituates with

repeated exposures or presentations. An intense or aversive environmental stimulus, on the other hand, evokes a defensive reaction characterized by phasic heart rate acceleration and nonhabituating skin conductance responses. (For a recent survey of physiological responses to environments see Weiss and Baum, 1987).

Autonomic activity has considerable relevance for leisure research because autonomic measures can be used to assess, for instance, stress as well as perceptual sensitivity to environmental stimuli. An important issue concerning autonomic activity has been whether specific emotional states are reflected by distinct patterns of autonomic responses. This has been demonstrated in a study by Ekman, Levenson, and Friesen (1983); they recorded several autonomic indicators and found that the autonomic nervous system differentiated between positive and different negative emotions. It has also been shown that the evoked autonomic reactions are consistent with reactions in other response levels or systems such as the muscular-expressive (facial) and experiential/cognitive (e.g., Dimberg, 1987a).

An alternative method developed in recent years for measuring emotional responses is the facial electromyographic (EMG) technique. This method is based on the proposition that human facial muscles constitute a biologically preprogrammed output system for emotional reactions (Darwin, 1872). Thus, emotional activity can be detected by attaching small skin electrodes over specific facial muscles which form the basis for displaying specific facial expressions of emotion (e.g., happiness, fear, anger). Several studies have demonstrated that the facial EMG technique is sensitive and can detect different emotional responses to a broad range of visual and auditory stimuli (e.g., Dimberg, 1986). There is limited evidence that facial EMG can differentiate attitudinal responses, perhaps especially when attitudes have a

salient emotional component (Petty and Cacioppo, 1983). Facial EMG response patterns are also congruent with responses evoked in the cognitive/experiential and the autonomic systems (for a review of research on facial EMG see Dimberg, 1989).

Returning to the concern for the applicability of psychophysiology to recreation and leisure issues, the following section describes research examples that illustrate how measurements of autonomic activity, facial EMG, and electrocortical activity can detect bodily reactions to landscape scenes and other environmental stimuli. These examples relate to perceptual intake and emotional responses in contexts where stress is not an issue. Later sections focus on research concerning stress.

Research Examples: Physiological Responses to Environmental Stimuli

In psychophysiology, one important way of defining human-environmental interactions has been in terms of perceptual intake and rejection (Lacey, 1967; Coles, 1984). Environmental intake (attention to external stimuli or events) is characterized by phasic or short-term heart rate deceleration, whereas sensory rejection is associated with heart rate acceleration. From this perspective it can be predicted that environmental stimuli which are experienced as positive or pleasant should automatically elicit an attentional response followed by an autonomic response pattern characterized by distinct heart rate deceleration. By contrast, environmental stimuli that are comparatively negative or less preferred should not evoke a large heart rate deceleration.

This prediction was investigated by Dimberg and Ulrich (1989) who exposed subjects to color slides of both preferred or positive natural scenes

(unspectacular high depth or spatially open environments) and less preferred natural views (low depth or spatially enclosed settings). Heart rate was monitored while subjects were seated in a laboratory and were repeatedly exposed to the different slides with a stimulus duration of eight seconds. The results for heart rate responses are illustrated in Figure 1. As predicted, the high depth scenes evoked a distinct phasic heart rate deceleration that was larger than the response to the less preferred low depth slides. These data support the notion that positive or preferred natural environments spontaneously elicit a physiological response indicating sensory intake/attention.

Insert Figure 1 about here.

Other research has demonstrated that the facial EMG technique can sensitively detect different physiological reactions to simple environmental stimuli such as tones of low intensity (75 dB) and high intensity (95 dB) (e.g., Dimberg, 1987b). High intensity auditory stimuli evoke a response dominated by increased corrugator muscle activity (the corrugator muscle is used when frowning in negative emotional expressions). Some subjects appraise a low intensity tone as unpleasant whereas others perceive the tone as neutral in terms of pleasantness. Those individuals who appraise such sounds as unpleasant react with clearly higher corrugator muscle response. These findings are paralleled by results from a pilot study by Dimberg and Ulrich who measured facial EMG while subjects were exposed to slides of natural landscapes that varied in rated preference levels. It was found that the overall

preference scores were negatively correlated with the overall evoked corrugator responses. In other words, scenes rated lower in preference elicited higher corrugator activity indicating a comparatively negative emotional reaction.

Responses to visual landscapes have also been investigated using measurements of electrocortical activity (Ulrich, 1981). Recordings were made of brain wave activity in the alpha frequency range while subjects viewed lengthy slide presentations of either natural or urban scenes. In general, higher levels of alpha activity are associated with lower levels of physiological arousal and with feelings of wakeful relaxation. Findings showed that alpha amplitudes were higher during the natural rather than urban exposures, which suggests that individuals were more wakefully relaxed when viewing nature. Likewise, self-ratings of affective states indicated that subjects had more positively-toned feeling states when viewing the natural scenes.

Advantages of Physiological Measures

Much research in the leisure benefits area has been based on verbal measures such as attitudinal scales or self-ratings. Compared to verbal indicators, the physiological measures used in psychophysiology can offer certain important advantages. Many of the physiological indicators described earlier can be recorded continuously during leisure experiences, thereby yielding insights concerning the temporal character or duration of effects, as well as the magnitude of beneficial consequences. Importantly, physiological methods can identify certain beneficial influences on well-being that probably are outside the conscious awareness of leisure participants, and

therefore may not be identified or assessed with validity using verbal measures (Ulrich, 1988). In this regard, only physiological procedures are suited to identifying and measuring such physiological consequences as reductions in blood pressure associated with recovery from stress (Ulrich and Simons, 1986). The use of physiological measures in leisure research will likely contribute to uncovering numerous important beneficial consequences that would otherwise remain hidden to investigators.

Another point in favor of psychophysiological approaches is that physiological findings tend to have scientific credibility. Also, considerable importance is often assigned to physiological data relating to well-being by courts and decisionmakers, and in some legislative situations. An indication of the credibility of physiological measures, and of the widespread acceptance of physiological well-being as an important societal value, is that findings regarding many physiological effects (e.g., blood pressure) usually are considered permissible data by courts (Ulrich, 1988). For instance, if physiological findings are presented regarding beneficial leisure consequences linked to a particular natural environment, courts are more likely to decide that these benefits must be considered in assessing the social value of the environment, often regardless of whether economic values can be assigned. Finally, physiological evidence of benefits, especially relating to consequences for physiological well-being, may carry weight in environmental impact statements.

In the case of most physiological measures, there are usually considerable advantages in using them in designs that combine physiological and verbal methods. Research approaches that obtain data from different response modes (physiological, verbal, and sometimes behavioral)--compared to studies that assess responses in only one mode, or employ a single type of

measure--yield a broader range of inferences or conclusions. Because one important indication of validity is the extent of consistency among results obtained from different measures and modes, psychophysiological approaches can offer the major advantage of allowing assessment of convergent validity. For instance, if findings from a study indicated a pattern of agreement among physiological and verbal indicators, this would suggest convergent validity and imply that the results justified confidence. Although verbal measures alone may be sufficient for investigating benefits in many situations, it should be noted that verbal methods should never be used alone to assess detrimental consequences associated with long-term environmental stressors or risks. For assessing negative consequences over a period of weeks or months, the validity of verbally-based indicators is exceedingly problematic. Validity considerations in stress research often dictate the use of integrated research approaches that combine physiological, verbal, and often behavioral indicators (Baum et al., 1985; Evans and Cohen, 1987; Ulrich, 1988).

Limitations of Physiological Measures

As with all methods, psychophysiological procedures have limitations or disadvantages which must be considered before undertaking research. Perhaps the main drawback is that these methods tend to be time consuming and expensive, especially compared to verbal measures. Most physiological procedures necessitate the recording of data from subjects on an individual basis, often for a considerable amount of time, which raises obstacles to the study of large samples. High quality equipment for psychophysiology is expensive, and its use and maintenance requires technical expertise. Certain physiological measures can be perceived by subjects as invasive, and may

therefore require a lengthy baseline or habituation period; combined with a long data collection session, this may produce undesirable effects on subjects such as irritability or fatigue. Also, the procedural requirements of physiological measures often constrain the activity of subjects. At the extreme, some physiological recordings are so sensitive to movement artifacts (e.g., brain wave activity) that subjects must be instructed to sit motionless in a comfortable chair during the data collection. Because of these constraints, several measures are difficult and awkward to use in field studies, and are more appropriate to laboratory research. However, some psychophysiological methods are well suited to field conditions, and hold great promise for advancing our understanding of leisure benefits. Also, rapid advances in electronics miniaturization are creating new opportunities for applying physiological measures in field settings. Lightweight, noninvasive, battery powered units worn by subjects can record or transmit important physiological responses such as heart rate.

STRESS AND LEISURE EXPERIENCES

Stress: Conceptual Perspectives

A stress reaction is the process whereby a person responds psychologically, physiologically, and often with behaviors, to a situation that threatens well-being (Baum, Singer, and Baum, 1982). The physiological component consists of many responses in different bodily systems, such as the autonomic and neuroendocrine, which mobilize the individual for coping with the situation. We will mainly use the word "stress" in a negative sense to refer to an undesirable state or condition that needs to be mitigated over time to

prevent decrements in human performance and well-being, including illness. Although stress is construed primarily as a deleterious phenomenon, certain short-term stressful situations can improve human performance in nonleisure and leisure behaviors (Evans and Cohen, 1987). A related point is that many so-called "adventure recreation" programs are premised on the notion that exposure to stressfully challenging situations creates benefits related to self-development (Ewert, 1987).

Several influential theoretical perspectives on human-environment interactions converge in predicting that if individuals are stressed, leisure encounters with most natural settings will have stress reducing influences -- while exposures to most urban environments may hamper recuperation (Ulrich at al., 1989). For instance, cultural and other learning-based perspectives suggest that Western cultures condition their inhabitants to prefer nature and dislike cities. Overload perspectives suggest that urban environments, compared to most natural settings, tend to have higher levels of complexity and other stimulation that place taxing processing demands that should slow or hamper restoration from stress (Cohen, 1978; Milgram, 1970). As another example, evolutionary perspectives premise that because humans evolved over millions of years in natural environments, we are to some degree physiologically and psychologically adapted to natural in contrast to urban settings. Authors who adopt the evolutionary position often contend that humans have an unlearned predisposition to attend and respond positively to natural content such as vegetation and water (e.g., Stainbrook, 1968; Driver and Greene, 1977; Kaplan and Kaplan, 1982; Ulrich, 1983). Because we lack evolutionary tuning for urban or built environments, experiences with such settings place greater demands on processing resources, and may require more coping or adaptation effort (Stainbrook, 1968). If an individual is

stressed, these demands should hamper recuperation. In sum, all of these perspectives, and others not discussed here (e.g., arousal theory), imply that leisure encounters with unthreatening natural environments, compared to the influences of most urban settings, should tend to foster greater recovery from stress. Accordingly, leisure environments, especially those which are predominately natural, may help prevent certain types of stress from existing or reduce their levels, particularly when the source is in the physical environment. Also, if the stressor is not tied to the physical environment (e.g., illness), even brief exposures to natural content may be positively distracting, producing positive feelings and blocking or reducing stressful thoughts (Ulrich, 1981). This implies that therapeutic natural settings or content might be integrated with living and work places, or they might be areas that can be used readily, such as a park or parkway.

A concept relevant to coping with stress during leisure is that of "temporary escape" (e.g., Driver and Knopf, 1975). This escape might be passive or mental only, such as through meditation, daydreaming about a favorite recreation area, or just gazing out a window at a pleasant natural view. Or the temporary escape might reflect active coping with a stressor, as when an individual actually travels to a recreation site or area. Kaplan and Talbot (1983) use the phrase "being away" in a manner similar to temporary escape, in the context of restoration that involves distancing oneself from negative distractions, or from one's day-to-day work. They also postulate that restorative influences of recreation in natural environments are fostered by attention-holding properties of nature, by coherent properties of nature that facilitate comprehension and confidence, and by compatibility between the recreationist's purposes and the actions or demands imposed by the setting (1983). It seems likely that many situations involving temporary escape are

stress reducing in part because the recreationist achieves some sense of control with respect to the stressor. Many studies on environmental stress have found that achieving control tends to reduce the negative effects of stressors (Evans and Cohen, 1987).

Stress Reducing Influences of Leisure Activities: Findings from Verbal Methods

There has been considerable research on the perceived therapeutic benefits of leisure activities in helping people cope with various stresses through temporary escape. The great majority of studies have employed questionnaires or self-report methods to evaluate the relative importance of particular leisure activities and settings in helping different types of recreationists cope with stress. Perhaps the best known is the work of Tinsley and his associates (e.g., Tinsley and Kaas, 1979), and Driver and his associates (e.g., Driver and Knopf, 1976). Tinsley and Driver, working separately and together, have developed two similar but different sets of psychometric instruments for identifying and measuring the motivational bases of recreation choice, some of which are clearly stress related. Findings from the many applications of these instruments, in several different locations and for different types of leisure activities, document rather convincingly the importance of leisure for stress mitigation. Some examples of typical results from this work are discussed below. (For a more detailed discussion of methods and findings see the chapter in this volume by Driver, Tinsley, and Manfredo.)

Tinsley and his associates identified 27 leisure activity-specific needs; these needs were quantified by using paragraphs about leisure (PAL) methodology. Each scale of the PAL consists of a single paragraph which

makes a statement about the particular leisure activity being studied, and respondents are instructed to indicate the extent to which each paragraph is an accurate statement about the leisure activity they are describing (Tinsley and Kaas, 1979). Several of the 27 scales (e.g., Compensation, Catharsis, and Independence) explicitly or implicitly tap leisure motivations related to coping with stress. Results of studies that have applied these scales to different types of recreationists participating in various activities in different locations show that leisure activities are important for helping people cope with stress as well as in meeting other non-stress related needs (e.g., Tinsley et al., 1985). Recently, Tinsley used factor analysis to reduce the 27 scales to eight "psychological benefits of leisure" (Tinsley and Tinsley, 1988). Although this resulted in loss of specificity, the theme of stress mitigation remains, such as in the benefit labelled "compensation."

While the work of Driver and his associates is theoretically similar to that of Tinsley and his colleagues, it differs considerably in orientation and methods. Specifically, the purposes are to define and measure the psychological bases of recreation demand (primarily for outdoor recreation opportunities) by quantifying the relative importance of specific persistent-over-time reasons for deciding to engage in chosen activities. In recent years the conceptual foundation of the work has been shifted to the expectancy-valence model of choice in social psychology, as Fishbein and Ajzen perfected their theory of reasoned action (e.g., Ajzen, 1985). After more than 50 empirical studies, the measurement instrument has evolved to contain 43 "Recreation Experience Preference" (REP) scales that assess specific types of experiences desired and expected from leisure activities. These scales are shown in Table 1, along with the 19 more general recreation experience preference domains into which the 43 REP scales can be logically and

empirically grouped. The REP scales were developed to facilitate management of recreation areas using an "experienced based" approach which requires targeting management objectives and prescriptions towards the provision of specified types of recreation experience opportunities identified by the REP scales (e.g., Manfredo et al., 1983).

Insert Table 1 about here

Several of the REP scales explicitly tap the theme of temporary escape from stress. (See especially Domains 3 and 4 in Table 1.) Considerable data have been obtained for these stress-related scales from over 100 empirical studies carried out by Driver, his associates, and others who have used the REP scales. For example, Table 2 shows the mean scores and rank order (RO) of the mean scores (within an activity) for seven outdoor recreation activities studied in northeastern Pennsylvania (Driver and Cooksey, 1980). Scales 1, 2, 4, 5, 7, and 9 are explicitly related to stress mediation, and others (12, 14, 15, 18, 20) may have some relation to stress. One can notice from the mean scores, and more quickly from the rank orders of such by activity, that various stress mediation/temporary escape items consistently fall in the top 5-6 most highly ranked experience preferences for each of the 7 recreation activities.

Insert Table 2 about here

Table 3 shows results for an early version of the REP scales that was administered to recreational users of the Au Sable River in Michigan (Driver, 1976). The data are displayed differently than in Table 2 to show the percentages of the three types of recreationists studied (canoeists, fishermen, and stream-bank owners of homes and cottages) who rated single item "expected consequences" (an early name for the REP scales) either Extremely Important or Very Important as a reason for using the river on the day when they were interviewed on site. Items 2, 3, 5, 6, 7, 8, and 10 are explicitly stress related, with the first several being rated of considerable importance by the recreationists.

Insert Table 3 about here

Table 4 shows findings from a study by Davis (1973) that used selected REP scales to evaluate motivations of users of the large Belle Isle Park, which is near downtown Detroit and is used by a high percentage of middle to very low income people. The table contains the mean scores for the 10 most highly rated scale items of the 40 included in the study. The results strongly suggest that temporary escape has considerable importance for these primarily inner-city recreationists.

Insert Table 4 about here

Data from scores of other studies that have used Tinsley's, Driver's, or related scales, could also be presented that would disclose patterns of findings

similar to those in Tables 1-4. But that seems unnecessary for drawing this conclusion: The conventional wisdom that recreation is important not only for growth and development but also for re-creation through stress mediation is strongly supported by the many studies on the motivational bases of leisure choice. This research consistently suggests that temporary escape benefits have comparatively high importance. This literature also indicates that leisure can have a wide variety of other stress mediating functions--and that different activities vary with respect to stress reducing benefits.

STRESS REDUCING INFLUENCES OF PASSIVE LEISURE EXPERIENCES: PHYSIOLOGICAL FINDINGS

To date, only a small amount of leisure-related research has used physiological procedures to investigate stress reduction benefits. Despite the limited amount of work, most findings suggest that passive leisure experiences can have significant positive psychophysiological consequences. For example, Heywood (1978) induced stress in subjects with a period of frustrating mental arithmetic, and then monitored stress recovery using a battery of physiological measures while the individuals had access to a variety of passive distractions-- e.g., watching television, reading, and listening to music. Findings suggested that if individuals perceived the distraction as potentially positive or enjoyable, significant stress recovery was observed as indicated by reductions in heart rate, skin conductance, upper back muscle tension, and respiration. However, when the potentially recreative experience was perceived as non-recreative or unenjoyable, less recovery occurred. The findings suggest that even a few minutes of passive leisure, if appraised

positively by participants, can produce substantial stress recuperation that is clearly evident in different bodily systems.

As discussed in an earlier section, various theoretical perspectives converge in predicting that if people are stressed, passive leisure encounters with most natural environments will have stress reducing influences, whereas many urban environments will hamper recovery. In a test of this notion, 120 subjects first viewed a stressful movie, and then were exposed to 10-minute color/sound videotapes of different natural and urban settings (Ulrich et al., 1989). Data concerning stress recovery during the environmental presentations were obtained from self-ratings of feeling states and from four physiological measures: heart rate, skin conductance, muscle tension, and pulse transit time, a non-invasive measure that correlates with systolic blood pressure. Findings from all measures, verbal and physiological, were consistent in indicating that recuperation from stress was much faster and more complete when individuals were exposed to the natural rather than urban environments. In the case of the physiological stress indicators, greater recovery influences of the natural settings were suggested by lower levels of skin conductance fluctuations, lower blood pressure (i.e., longer pulse transit times), and greater reductions in muscle tension (Figures 2-4). Likewise, results from affective self-ratings suggested that much more recuperation in the psychological component of stress was produced by the natural environments. In contrast to the urban environments, the natural settings produced greater reductions in feelings of fear and anger/aggression, and were associated with far higher scores for positive feelings such as "elated or pleased." The pattern of convergence across data from different response modes, physiological and verbal, suggests that the main conclusion regarding

greater stress reducing effects of the natural environments justifies confidence.

Insert Figures 2-4 about here.

In the same study, heart rate data revealed directionally different responses during stress recovery to the natural versus urban environments; heartrate following onset of the nature presentations decelerated, whereas cardiac acceleration occurred during the urban exposures (Figure 5). As discussed in an earlier section, when an individual is at rest, a response of cardiac deceleration with respect to external stimulation indicates perceptual intake or attention/interest (Lacey and Lacey, 1970; Coles, 1984). On the other hand, acceleration suggests perceptual rejection of an external stimulus. Accordingly, the results in Figure 5 support the conclusion that perceptual intake was much higher while individuals experienced the natural settings. These findings raise the possibility that strong intake/attention eliciting properties of nature may be an important mechanism in restoration during leisure experiences in natural environments. Authors in behavioral medicine and environment-behavior fields have advanced the notion that external distraction or attention with respect to a positive, non-taxing stimulus can effectively reduce stress or anxiety (e.g., Stoyva and Anderson, 1982; Kaplan and Kaplan, 1982).

Insert Figure 5 about here.

Importantly, the physiological data above suggest that the natural settings elicited responses dominated by the parasympathetic nervous system. Parasympathetically dominated responsiveness is associated with perceptual sensitivity and restoration of physical energy. Another noteworthy finding from this study was the rapidity of recuperation during natural exposures. After 4-6 minutes of exposure to the natural environments, significantly greater recuperation compared to the urban experiences was evident in all physiological measures (Figures 2-5). In view of the quickness of recovery influences, it seems plausible to speculate that even short duration leisure contacts with nature might be important to many urbanites in fostering restoration from mild stressors such as daily hassles or annoyances (Ulrich et al., 1989). While the findings cannot be generalized directly to longer term leisure experiences in natural environments, including wilderness recreation, the results probably are relevant to advancing our understanding of mechanisms involved in the stress reduction that many wilderness users report is a very important benefit of their experiences--as discussed in the previous sections.

Apart from physiological and psychological components, stressor effects often include reduced performance levels on tasks involving attention and cognitive processing. Recently, a series of two studies investigated whether enhanced task performance is among the benefits of restorative leisure experiences in natural environments (Hartig et al., 1987). Findings

from the first study suggested that a group who participated in a backpacking trip, compared to control groups, evidenced somewhat higher performance on a proofreading test. Also, the backpacking group had higher scores in terms of overall positive feelings. Results from the second study suggested that following a stressor, individuals who had taken a 40 minute walk in a natural setting had more positively-toned feelings than subjects who had experienced either an urban walk or who relaxed while reading magazines or listening to music. However, there were no differences in recovery among the three groups as indicated by physiological data such as blood pressure and heart rate. In view of the rapidity of stress recovery that can occur during nature exposures (Ulrich et al., 1989), it seems possible that potential differences in physiological recuperation may not have been detected because recordings were delayed until after the 40-minute recovery/leisure periods (Hartig et al., 1987).

Apart from these leisure related investigations, a growing number of studies have reported substantial restoration benefits of nature exposures in health care and other stressful situations. Ulrich found that hospital patients recovering from surgery had more favorable postoperative courses if their windows overlooked trees rather than a brick building wall (Ulrich, 1984). In the hospital study, therapeutic influences of the natural window views were evident in behavioral indicators, including shorter length of stay, lower intake of strong pain drugs, and more favorable evaluations by nurses. The hospital results are echoed in findings from research conducted in prisons suggesting that cell window views of nature are associated with lower frequencies of stress symptoms such as digestive illness and headaches, and with fewer sick calls by prisoners (Moore, 1982; West, 1986). Katcher and his colleagues used a combination of physiological and verbal measures to show

that passive contemplation of a different configuration of natural content--an aquarium--reduced stress associated with dental surgery (Katcher et al., 1984).

STRESSFUL EFFECTS OF CHALLENGING OUTDOOR EXPERIENCES

Implicit in the above survey of findings was the perspective that stress tends to be a deleterious phenomenon, and that reduction of stress is beneficial. However, a different interpretation of stress usually underpins outdoor recreation programs which deliberately involve participants in challenging activities that are psychologically and physiologically stressful. The rationale for such programs often rests on the assumption that certain stressful or risky activities are appraised by many participants as positive or even exhilarating, and accordingly have beneficial consequences. Some programs are based on the premise that even quite negatively stressful activities are warranted if they also produce important long-term benefits such as enhanced self-esteem or identity.

It appears that no research has yet used psychophysiological methods to examine possible long-term beneficial "aftereffects" of a stressfully challenging recreation experience. However, a few investigations have employed physiological measures to assess the extent to which challenging activities may be immediately taxing or stressful. In one study, heart rate was monitored continuously while subjects engaged in a sequence of high "ropes course" events (Little et al., 1986). After completion of three events that involved physical exertion, mean heart rate for the subjects had risen to 114 bpm. The fourth event--called a Zip Line--required comparatively little physical exertion; subjects stepped off a high platform and rode down a 315' cable in a seat harness attached to the line by a pulley. The first segment of

the trip was a freefall of 20 feet. During the Zip Line event, mean heart rate rose to 180 bpm. This finding implies that the psychological thrill or stress/anxiety of the Zip Line experience, not physical exertion, was largely responsible for the extreme cardiac reactivity reflected in the mean heart rate increase of 66 bpm. In the case of four subjects (total=14), maximum heart rates during the Zip Line reached at least 220 bpm. For older or unfit participants, any positive dimension of such an experience probably could only be psychological; the physiological effects of the event might be considered so stressful as to present a health risk.

Bunting and her colleagues used a combination of verbal and physiological measures to investigate stress associated with rock climbing and rappelling (Bunting et al., 1986). None of the individuals in the study had previous experience with these challenging, risky activities. Measures included self-ratings of anxiety, heart rate recordings, and stress hormones in urine (epinephrine and norepinephrine). Data were obtained for each measure during a lengthy baseline period, during a three hour anticipatory period, and after each activity. Findings from all measures converged in indicating that both physically fit and low-fit subjects experienced substantial anticipatory stress, with low-fit individuals experiencing the highest levels. For instance, the mean heart rate of the low-fit group just prior to rappelling was 127 bpm. Levels of stress hormones were higher for both fit and low-fit subjects during the anticipation phase than during baseline; epinephrine excretion during anticipation was especially high for the low-fit group, suggesting greater anticipatory stress. As expected, stress hormone levels were generally highest after the activities, reflecting the combined effects of physical exertion and psychological stress on neuroendocrine responses.

Although the amount of psychophysiological research on challenging recreation activities is limited, findings nonetheless indicate clearly that the short-term effects of such activities can include negative stress-- e.g., anxiety, perhaps cardiovascular stress, and high levels of circulating stress hormones that might have deleterious influences. It appears that the "eustress" or beneficial stress hypothesis regarding challenging outdoor programs may not apply to many individuals from the standpoint of short-term influences. Certain challenging activities may place excessive or even hazardous physiological demands on many individuals, including those with low levels of physical fitness and those with strong psychological reactivity to the activities.

A POSSIBLE STUDY: STRESS RECOVERY BENEFITS OF VIEWING NATURE FROM THE ROAD

Within the perspective of the previous sections on stress, the following outlines the major features of a field study that could be conducted to advance understanding regarding stress reducing effects of leisure. The research would employ a battery of physiological measures, in combination with verbal indicators, to investigate possible restorative influences of an important type of leisure experience-- viewing roadside environments from a moving vehicle. Although the primary objective would be to assess stress recovery, the study would also yield findings concerning a number of other issues relevant to recreation and leisure research, such as short-term attention and emotional responses to different landscapes as seen from the road.

1. Subjects would be studied individually in a small instrumented passenger van having a comfortable seat positioned next to a large curtained side

window. The driver would be separated by a partition from the second row area where the subject would be seated. With the van stationary and the window covered, the physiological recording devices would be affixed and instructions given to the subject. Instrumentation in the van (not visible to the subject) would allow continuous monitoring of heart rate, skin conductance, pulse transit time (blood pressure correlate), and perhaps facial EMG.

2. Baseline phase. With the window still covered by the curtain, the van would be driven for 10 minutes, during which time the subject would habituate to the recording devices, and baseline physiological data would be obtained. Also, the individual would complete a short state emotions questionnaire.

3. Stressor phase. The van would then park and a 10 minute stressor videotape would be displayed on a monitor in front of the subject. After cessation of the stressor, self-ratings would again be obtained. (As alternatives to displaying a videotape to produce stress, there are possibilities for studying subjects who are stressed naturally due to work, ill health, or other factors.)

4. Recovery from stress phase. The van would then begin moving at 25-30 mph, and the curtain covering the window would open to display one of three categories of roadside view sequences: (1) spectacular nature, (2) unspectacular nature, or (3) urban. A random procedure would be used to assign subjects to the roadside environment conditions. During this "leisure ride" recovery phase, lasting 20-30 minutes, the continuously recorded physiological data would indicate the extent to which the various roadside environments fostered or hindered recuperation from stress. Also, the physiological data would probably reveal levels of phasic

attention/intake responses, as well as emotional reactions, to particular landscape features or views comprising each of the three environmental conditions. At the conclusion of the recovery phase, self-ratings of feeling states would again be obtained.

5. Anticipated findings. It is expected that the physiological and verbal data would indicate that recuperation from stress would occur most rapidly and completely during the spectacular nature condition. Comparatively moderate restoration might be produced by the unspectacular nature; least recovery would be expected during the urban trip segment. Perhaps the findings would suggest that different types of roadside environments during leisure trips can have quite different effects on psychophysiological well-being.

RESEARCH NEEDS, DIRECTIONS, CHALLENGES

Because only a limited amount of leisure research to date has used psychophysiological methods, there are conspicuous research needs in most areas relating to leisure benefits. A priority need is for research that identifies positive consequences for physiological well-being that may be outside the conscious awareness of leisure participants (e.g., reduced blood pressure), and hence may not have been identified previously by studies using verbal methods. Another major requirement is for a program of psychophysiological studies to corroborate benefits already identified by verbally-based approaches. Most findings in leisure research have been obtained from verbal methods such as questionnaires; where possible, it is important that these findings be validated by obtaining convergent results from psychophysiological or other procedures.

Achieving the great potential of psychophysiology for leisure research will require major efforts in undertaking both laboratory and field studies. Laboratory studies using physiological measures offer some very important advantages, such as precise, temporally continuous recordings of several indicators in different bodily systems. But the extent to which laboratory findings can be extended to real world situations often is limited by external and ecological validity considerations. One strategy for advancing research on leisure benefits would be to rely heavily on laboratory studies for initial testing of hypotheses or for identifying relationships or main effects-- and then confirming such effects in field studies that usually would be more time consuming and costly than the laboratory predecessors, but might be stronger from the standpoint of external or ecological validity concerns. Although field studies have certain important strengths, they often present difficult control problems because the complexity of real situations typically introduces several variables or variations in conditions that can be excluded or held constant in laboratory research. Whether conducted in laboratory or field settings, psychophysiological research generally requires technical expertise and other knowledge in areas unfamiliar to leisure researchers with social science backgrounds-- e.g., electrical apparatus, physiology, biochemistry. This point implies that progress in applying psychophysiological methods to leisure issues will occur much faster if leisure scientists work together with psychophysiologists in interdisciplinary teams having the necessary range of skills.

At a very general level, two broad categories of leisure research can be distinguished on the basis of the temporal nature of the benefits in question. One category is concerned with <u>short-term</u> positive consequences-- i.e., beneficial effects that can be detected during or immediately following a

leisure experience (e.g., positive emotional responses, lower blood pressure). The second broad category investigates comparatively long-term consequences for well-being-- that is, benefits that can be detected days, weeks, or even months after a leisure or recreation episode. Regarding the former, physiological methods are exceptionally well-suited to the continuous monitoring of short-term effects or responses, especially when the leisure experience is passive or involves little physical activity. Research is also needed on the short-term psychophysiological consequences of active leisure or recreation experiences. However, this direction presents investigators with difficult challenges stemming from the fact that nearly all physiological responses are affected by physical activity or exercise. For instance, if recordings of blood pressure were obtained for an active wilderness hiker, the data could not be used for inferring, say, stress reducing influences of natural scenery-- unless the design controlled for, among other factors, the effects on blood pressure of the hiker's physical exertion. Overcoming the confounding effects of exertion will require carefully conceived research designs that, for instance, hold physical exertion constant while relating possible variations in physiological indicators to systematic changes in other components of the leisure experience.

Apart from studies of short-term benefits, there is a clear need for research that documents longer term psychophysiological consequences of leisure. From a long-term perspective, it becomes important to know, for example, whether stress reduction associated with a wilderness fishing trip might persist for several days after the experience. The determination of possible long-term psychophysiological benefits of leisure episodes will eventually require longitudinal or followup studies that span several weeks or months. This research direction is especially important because if long-term

benefits are documented (e.g., a persistent reduction in blood pressure associated with repeated leisure episodes), it may prove warranted to link the consequences to health-related benefits such as decreased risk for hypertension. One promising approach for investigating long-term benefits is psychoimmunology. In recent years medical studies have found that stress can have suppressive effects on the immune system, as evidenced, for instance, in lower levels of lymphocytes (e.g., Schleifer at al., 1983). In turn, reduced lymphocyte levels or activity can be associated with increased susceptibility to illness. Conceivably, future leisure research might reveal that an important benefit of frequent or prolonged restorative experiences is an increase in lymphocyte levels and accordingly greater resistance to illness.

Another important issue relating to long-term consequences concerns the extent to which challenging, stressful outdoor recreation programs may have beneficial effects in the long run. As discussed in an earlier section, there is limited evidence from psychophysiological studies suggesting that certain challenging activities can have short-term effects that are quite negatively stressful for some participants. There is a conspicuous need for psychophysiological research that tests whether such influences are indeed transformed over time into benefits that justify the short-term stressful consequences.

Finally, the earlier discussion of benefits associated with natural environments implies a research consideration that applies to both short-term and long-term contexts. In studies concerned with positive physiological consequences of nature, research designs should be quasi-experimental, or have control groups or other environmental comparisons, to allow sound inferences regarding the role of nature. In the absence of such designs, findings regarding nature will be vulnerable on the grounds, for instance,

that a comparable leisure activity in different surroundings (e.g., a city) conceivably could produce similar benefits.

SUMMARY AND CONCLUSIONS

In addition to their importance for investigating benefits derived from physical exercise, physiological measures have great promise for identifying many other leisure benefits that may or may not be related to physical exertion, such as stress recovery. The main focus of this paper is on the use of psychophysiological methods to investigate the role of leisure activities and leisure environments, particularly natural environments, in helping people cope with stress. "Psychophysiological" refers to approaches that measure physiological responses as they relate to attention, cognition, emotions, and stress related reactions.

Compared to verbal measures, physiological measures used in psychophysiology have certain significant advantages such as allowing temporally continuous recordings of influences of leisure experiences. Also, findings obtained from physiological procedures tend to have scientific credibility, often carry weight in environmental impact statements, and typically are considered permissible data by courts. On the other hand, physiological methods tend to be time consuming and expensive, especially compared to verbal measures. Some physiological procedures are difficult and awkward to use in field studies, and are better suited to laboratory conditions. However, certain psychophysiological methods are well suited to field studies. Importantly, physiological research approaches can identify certain beneficial effects on well-being that probably are outside the conscious awareness of leisure participants, and accordingly may not be identified or

assessed with validity using verbal measures (e.g., influences on blood pressure). For decades, physiological measures have been of major importance in identifying detrimental human effects of toxic substances in the environment. Only recently has a beginning been made in using this powerful category of methods to identify what may eventually prove to be several important benefits of leisure.

A stress response in contrast to relaxation is associated with increased physiological activity evident in many responses--e.g., heart rate, blood pressure, skin conductance, muscle tension, blocking of alpha EEG activity, and higher levels of stress hormones such as epinephrine. Also, there is considerable evidence that different emotional reactions or states--which are an important component of stress or well-being--are associated with different bodily reactions. An especially promising method for measuring emotional responses is the facial EMG technique. To illustrate how physiological measures can detect responses to environmental stimuli, findings are presented which suggest that both facial EMG and heart rate can discriminate between responses to landscape scenes varying in rated preference levels.

Several theoretical perspectives on human-environment interactions converge in predicting that if individuals are stressed, leisure encounters with most natural settings will have stress reducing influences, whereas exposures to many urban environments may hamper recuperation. A concept relevant to coping with stress during leisure experiences in natural environments is "temporary escape." Findings from scores of studies using verbal measures indicate that various temporary escape/stress mitigation benefits consistently are rated by outdoor recreationists as very important consequences of their leisure experiences. To date, only a small amount of research has used physiological methods to investigate stress reduction

benefits of leisure encounters with natural environments. Although limited, the findings strongly suggest that recuperation from stress occurs much faster and more completely when individuals are exposed to natural rather than urban environments. Results suggest a parasympathetically dominated response to natural views, but not to urban scenes. Likewise, findings from verbal methods indicate that more recuperation in the psychological component of stress can be produced by natural environments. Heart rate data raise the possibility that strong intake/attention eliciting properties of nature may be one important mechanism in restoration from stress that occurs during leisure experiences in natural settings.

Some outdoor recreation programs are based on the assumption that quite challenging or negatively stressful activities are justified because they may produce important long-term benefits such as enhanced self-esteem or identity. Findings from psychophysiological research on challenging activities clearly suggest that the short-term effects of such activities can include negative stress--as indicated, for instance, by cardiovascular responses and high levels of circulating stress hormones that might have deleterious influences. This research suggests that the "eustress" or beneficial stress hypothesis regarding challenging programs does not apply to many participants from the standpoint of short-term effects. Apart from the issue of short-term consequences, there is a need for research that investigates longer term psychophysiological influences of leisure, including challenging programs.

Achieving the great potential of psychophysiology for leisure research will require programs that include both laboratory and field studies. A priority need is for research that cross-checks the results of verbally based methods with those obtained from physiological and behavioral measures.

Over time, such triangulation will contribute to a deeper and more well-grounded understanding of stress-reducing and other benefits of leisure.

REFERENCES

Ajzen, I. (1985). From intentions to action: A theory of planned behavior. In J. Kuhl and J. Bechman (Eds.), Action-Control: From Cognition to Behavior. Heidelberg: Springer, pp. 11-39.

Baum, A., Fleming, R., and Singer, J. E. (1985). Understanding environmental stress: strategies for conceptual and methodological integration. In A. Baum and J. E. Singer (eds.), Advances in Environmental Psychology, Vol.5: Methods and Environmental Psychology. Hillsdale, New Jersey: Lawrence Erlbaum, pp. 185-205.

Baum, A., Singer, J. E., and Baum, C. S. (1982). Stress and the Environment. In G. W. Evans (ed.), Environmental Stress. New York: Cambridge University Press, pp. 15-44.

Bunting, C. J., Little, M. J., Tolson, H., and Jessup, G. (1986). Physical fitness and eustress in the adventure activities of rock climbing and rappelling. Journal of Sports Medicine and Physical Fitness, 26, 11-20.

Cohen, S. (1978). Environmental load and the allocation of attention. In A. Baum, J. E. Singer, and S. Valins (Eds.), Advances in Environmental Psychology, Vol. 1. Hillsdale, New Jersey: Lawrence Erlbaum.

Coles, M. G. H. (1984). Heart rate and attention: The intake-rejection hypothesis and beyond. In M. G. H. Coles, J. R. Jennings, and J. A. Stern (Eds.), Psychophysiological Perspectives. New York: Van Nostrand, pp. 276-294.

Darwin, C. (1872). The Expression of Emotion in Man and Animals. London: Murray.

Davis, R. L. (1973). Selected Motivational Determinants of the Recreational Use of Belle Isle Park in Detroit. Unpublished Master's thesis. School of Natural Resources, University of Michigan, Ann Arbor.

Dimberg, U. (1986). Facial reactions to fear-relevant and fear-irrelevant stimuli. Biological Psychology, 23, 153-161.

Dimberg, U. (1987a). Facial reactions, autonomic activity and experienced emotion: A three component model of emotional conditioning. Biological Psychology, 24, 105-122.

Dimberg, U. (1987b). Facial reactions and autonomic activity to auditory stimuli with high and low intensity. Psychophysiology, 24, 586.

Dimberg, U. (1989). Facial electromyography and emotional reactions. Psychophysiology. (In press).

Dimberg, U. and Ulrich, R. (1989). Autonomic reactions to spatially restricted and open environments. (In preparation).

Driver, B. L. and Knopf, D. C. (1975). Temporary escape: One product of sport fisheries management. Fisheries. 1(2):24-29.

Driver, B. L. (1976). Quantifications of outdoor recreationists' preferences. In B. Smissen and J. Meyers (Eds.), Research: Camping and Environmental Education, HPEP Series No. 11. University Park, PA: Pennsylvania State University, pp. 165-187.

Driver, B. L. and Greene, P. (1977). Man's nature: innate determinants of response to natural environments. In Children, Nature, and the Urban Environment. USDA Forest Service Report NE-30. Upper Darby, Pennsylvania: Northeastern Forest Experiment Station, pp. 63-70.

Driver, B. L. and R. W. Cooksey. (1980). Preferred psychological outcomes of recreational fishing. In A. Barnhart and T. D. Roelofs (Eds.). Catch-And-Release Fishing As A Management Tool: A National Sport Fishing Symposium. Humboldt State University. Arcata, California, pp. 27-40.

Ekman, P., Levenson, R. W. and Friesen, W. V. (1983). Autonomic nervous system activity distinguishes among emotions. Science, 221, 1208-1210.

Evans, G. W. and Cohen, S. (1987). Environmental stress. In D. Stokols and I. Altman (Eds.), Handbook of Environmental Psychology (2 vols.). New York: John Wiley, pp. 571-610.

Ewert, A. (1988). The identification and modification of situational fears associated with outdoor recreation. Journal of Leisure Research, 20, 106-117.

Grings, W. W. and Dawson, M. E. (1978). Emotions and Bodily Responses: A Psychophysiological Approach. New York: Academic Press.

Hartig, T., Mang, M. and Evans, G. W. (1987). Perspectives on wilderness: Testing the theory of restorative environments. Paper presented at the 4th World Wilderness Congress, Estes Park, Colorado, September, 1987.

Heywood, L. A. (1978). Perceived recreation experience and the relief of tension. Journal of Leisure Research, 10, 86-97.

Kaplan, S. and Kaplan, R. (1982). Cognition and Environment. New York: Praeger.

Kaplan, S. and Talbot, J. F. (1983). Psychological benefits of a wilderness experience. In I. Altman and J. F. Wohlwill (Eds.). Behavior and the Natural Environment. New York: Plenum, pp.

Katcher, A., Segal, H. and Beck, A. (1984). Comparison of contemplation and hypnosis for the reduction of anxiety and discomfort during dental surgery. American Journal of Clinical Hypnosis, 27, 14-21.

Lacey, J. I. (1967). Somatic response patterning and stress: Some revisions of activation theory. In M. H. Appley and R. Trumbull (Eds.), Psychological Stress: Issues in Research. New York: Appleton-Century-Crofts.

Lacey, J. I. and Lacey, B. C. (1970). Some autonomic-central nervous system interrelationships. In P. Black (ed.), Physiological Correlates of Emotion. New York: Academic Press, pp. 205-227.

Little, M. J., Bunting, C. J., and Gibbons, E. S. (1986). Heart rate responses to high ropes course events. Texas HPERD Journal, October, 38-42.

Manfredo, M. J., Driver, B. L. and Brown, P. J. (1983). A test of concepts inherent in experience-based management of outdoor recreation areas. Journal of Leisure Research, 15, 263-283.

Milgram, S. (1970). The experience of living in cities. Science, 167, 1461-1464, 1468.

Moore, E. O. (1982). A prison environment's effect on health care service demands. Journal of Environmental Systems, 11, 17-34.

Petty, R. E. and Cacioppo, J. T. (1983). The role of bodily responses in attitude measurement and change. In J. T. Cacioppo and R. E. Petty (Eds.). Social Psychophysiology: A Sourcebook. New York: Guilford, pp. 51-101.

Schleifer, S., Keller, S., Camanno, M., Thornton, J., and Stein, M. (1983). Suppression of lymphocyte stimulation following bereavement. Journal of the American Medical Association, 250, 374-377.

Stainbrook, E. (1968). Human needs and the natural environment. In Man and Nature in the City. Proceedings of a symposium sponsored by the Bureau of Sport Fisheries and Wildlife. Washington, D.C.: U. S. Department of the Interior, pp. 1-9.

Stoyva, J. and Anderson, C. (1982). A coping-rest model of relaxation and stress management. In L. Goldberger and J. Breznitz (Eds.), Handbook of Stress: Theoretical and Clinical Aspects. New York: The Free Press, pp. 745-763.

Tinsley, H. E. A. and Kass, R. A. (1979). The latent structure of the need satisfying properties of leisure activities. Journal of Leisure Research, 11, 278-291.

Tinsley, H. E. A., Teaff, J. D., Colbs, S. L., and Kaufman, N. (1985). A system of classifying leisure activities in terms of the psychological benefits of participation reported by older persons. Journal of Gerontology, 40, 172-178.

Tinsley, H. E. A. and Tinsley, D. J. (1988). An expanded context for the study of career decision making, development and maturity. In W. B. Walsh and S. H. Osipow (Eds.), Career Decision Making. Hillsdale, NJ: Lawrence Erlbaum Associates, pp. 213-264.

Ulrich, R. S. (1981). Natural versus urban scenes: some psychophysiological effects. Environment and Behavior, 13, 523-556.

Ulrich, R. S. (1983). Aesthetic and affective response to natural environment. In I. Altman and J. F. Wohlwill (Eds.), Human Behavior and Environment, Vol. 6: Behavior and the Natural Environment. New York: Plenum, pp. 85-125.

Ulrich, R. S. (1984). View through a window may influence recovery from surgery. Science, 224, 420-421.

Ulrich, R. S. and Simons, R. F. (1986). Recovery from stress during exposure to everyday outdoor environments. In J. Wineman, R. Barnes, and C. Zimring (Eds.), Proceedings of the Seventeenth Annual Conference of the Environmental Design Research Association. Washington, D.C.: EDRA, pp. 115-122.

Ulrich, R.S. (1988). Toward integrated valuations of amenity resources using nonverbal measures. In G. L. Peterson, B. L. Driver, and R. Gregory (Eds.), Amenity Resource Valuation: Integrating Economics with Other Disciplines. State College, PA: Venture, pp. 87-100.

Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., and Zelson, M. (1989). Stress recovery during exposure to natural and urban environments. (In review.)

Weiss, L. and Baum, A. (1987). Physiological aspects of environment-behavior relationships. In E. H. Zube and G. T. Moore (Eds.), Advances in Environment, Behavior, and Design, Vol. 1. New York: Plenum, 221-247.

West, M. J. (1985). Landscape Views and Stress Response in the Prison Environment. Unpublished M.L.A. thesis. Department of Landscape Architecture, University of Washington, Seattle.

Table 1

Recreation Experience Preference (REP) Scales Making Up the Recreation Experience Preference Domains[1]

1. Enjoy nature
   - A. Scenery
   - B. General nature experience
2. Physical fitness
3. Reduce tension
   - A. Tension release
   - B. Slow down mentally
   - C. Escape role overloads
   - D. Escape daily routine
4. Escape physical stressors
   - A. Tranquility/solitude
   - B. Privacy
   - C. Escape crowds
   - D. Escape noise
5. Outdoor learning
   - A. General learning
   - B. Exploration
   - C. Learn geography of area
   - D. Learn about nature
6. Share similar values
   - A. Be with friends
   - B. Be with people having similar values
7. Independence
   - A. Independence
   - B. Autonomy
   - C. Being in control
8. Family relations
   - A. Family kinship
   - B. Escape family
9. Introspection
   - A. Spiritual
   - B. Personal values
10. Be with considerate people (social security)
11. Achievement/stimulation
    - A. Reinforcing self-confidence
    - B. Social recognition
    - C. Skill development
    - D. Competence testing
    - E. Seeking excitement
    - F. Endurance
    - G. Telling others
12. Physical rest
13. Teach/lead other
    - A. Teaching/sharing skills
    - B. Leading others
14. Risk taking
15. Risk reduction
    - A. Risk moderation
    - B. Risk prevention
16. Meet new people
    - A. Meet new people
    - B. Observe other people
17. Creativity
18. Nostalgia
19. Agreeable temperatures

[1] Individual REP scales are designated by capital letters if there are more than one scale per domain and by the name given the domain when there is only one scale per domain.

Table 2. Mean Scores on Preferred Psychological Outcome Scales by Participants in Seven Activities in Pennsylvania. (RO) designates rank order of mean scores, with tied scores given the same rank. Standard deviations are in parentheses.)[a]

	Psychological Outcome	Camping			Picnicking			Lake Swimming			Pool Swimming			Motor Boating			Lake Fishing			Stream Fishing			Max. Diff
		RO	x	(sd)	RO	x	(sd)	RO	x	(sd)	RO	x	(sd)	RO	x	(sd)	RO	x	(sd)	RO	x	(sd)	in x's [b]
1.	Escape Daily Routine	3	3.9	(1.2)	4	3.1	(1.7)	3	3.6	(1.1)	1	3.5	(1.4)	1	4.5	(1.3)	1	4.3	(1.3)	2	4.0	(1.3)	1.4
2.	Physical Rest			[c]										4	3.9	(1.5)	1	4.3	(1.5)	2	4.0	(1.4)	
3.	Enjoy Nature	1	4.4	(1.2)	1	3.7	(1.3)	1	4.0	(1.2)	1	3.5	(1.5)	6	3.6	(1.2)	4	3.8	(1.4)	2	4.0	(1.2)	0.9
4.	Escape Physical Pressures	7	3.3	(1.4)	8	2.6	(1.6)	6	3.2	(1.1)	9	2.5	(1.3)	2	4.2	(1.5)	2	4.1	(1.7)	1	4.1	(1.3)	1.7
5.	Tranquility - Privacy	1	4.4	(1.2)	1	3.7	(1.2)	2	3.8	(1.3)	4	3.2	(1.4)	7	3.5	(1.3)	3	3.9	(1.3)	3	3.7	(1.0)	1.2
6.	Be With Other People	4	3.8	(1.3)	2	3.6	(1.3)	2	3.8	(1.2)	3	3.3	(1.4)	3	4.0	(1.1)	6	3.4	(1.4)	8	2.9	(1.1)	1.1
7.	Slow Down Mentally	6	3.4	(1.4)	6	2.9	(1.8)	5	3.3	(1.1)	5	3.1	(1.5)	9	3.2	(1.4)	5	3.5	(1.4)	5	3.4	(1.2)	
8.	Exercise - Physical Fitness	8	3.2	(1.4)	8	2.6	(1.6)	4	3.4	(1.2)	1	3.5	(1.6)	8	3.4	(1.4)	7	3.1	(1.5)	4	3.5	(1.3)	0.9
9.	Escape Role Overloads	5	3.7	(1.5)	5	3.0	(1.8)	3	3.6	(1.2)	2	3.4	(1.5)	7	3.5	(1.5)	6	3.4	(1.6)	6	3.3	(1.6)	0.7
10.	Family Togetherness	2	4.0	(1.6)	3	3.4	(1.9)	6	3.2	(1.3)	1	3.5	(1.7)	5	3.7	(1.3)	8	3.0	(1.7)	10	2.7	(1.2)	1.3
11.	Learning - Discovery	8	3.2	(1.2)	5	3.0	(1.3)	6	3.2	(1.2)	8	2.6	(1.3)	8	3.4	(1.3)	9	2.8	(1.4)	7	3.2	(1.1)	0.8
12.	Security	8	3.2	(1.3)	8	2.6	(1.6)	7	3.1	(1.2)	7	2.8	(1.3)	10	3.0	(1.5)	10	2.7	(1.5)	11	2.6	(1.3)	
13.	Nostalgia	8	3.2	(1.4)	7	2.7	(1.7)	8	3.0	(1.2)	8	2.6	(1.4)	12	2.8	(1.4)	8	3.0	(1.6)	8	2.9	(1.4)	
14.	Independence - Autonomy	9	2.7	(1.3)	10	2.3	(1.5)	8	3.0	(1.2)	9	2.5	(1.4)	13	2.7	(1.3)	11	2.6	(1.3)	9	2.8	(1.1)	
15.	Agreeable Temperatures													12	2.8	(1.6)	12	2.5	(1.5)	8	2.9	(1.4)	
16.	Teaching - Sharing Skills	11	2.4	(1.2)	9	2.5	(1.2)	11	2.7	(1.2)	10	2.2	(1.3)	13	2.7	(1.5)	12	2.5	(1.5)	11	2.6	(1.2)	
17.	Meet and Observe Other People	9	2.7	(1.3)	8	2.6	(1.2)	9	2.9	(1.4)	6	3.0	(1.4)	11	2.9	(1.2)	12	2.5	(1.3)	13	2.4	(1.2)	
18.	Introspection	10	2.5	(1.2)	8	2.6	(1.4)	10	2.8	(1.2)	10	2.2	(1.3)	15	2.3	(1.4)	13	2.4	(1.5)	13	2.4	(1.3)	
19.	Achievement	11	2.4	(1.1)	9	2.5	(1.2)	10	2.8	(1.2)	10	2.2	(1.2)	14	2.5	(1.3)	14	2.2	(1.2)	12	2.5	(1.1)	
20.	Seek Stimulation													17	1.9	(0.8)	15	2.0	(1.1)	13	2.4	(1.1)	
21.	Creativity	10	2.5	(1.1)	8	2.6	(1.2)	10	2.8	(1.2)	10	2.2	(1.1)	18	1.8	(1.1)	15	2.0	(1.3)	13	2.4	(1.3)	1.0
22.	Spiritual	12	2.2	(1.2)	10	2.3	(1.2)	12	2.5	(1.2)	11	1.8	(1.0)	16	2.0	(1.3)	15	2.0	(1.3)	14	2.2	(1.3)	0.7
23.	Social Recognition													18	1.8	(1.1)	16	1.6	(1.1)	15	2.1	(1.3)	
24.	Risk Taking	13	1.7	(0.9)	11	2.1	(1.1)	12	2.5	(1.3)	11	1.8	(1.0)	19	1.6	(0.8)	17	1.4	(0.8)	16	2.0	(1.2)	1.1
	Sample Size		535			406			241			268			100			122			104		

[a]/Rating was done on a 6-point Likert-type response format on which I designated "not important" and 6 designated "extremely important."

[b]/This column shows the maximum difference in mean scores across activities when means differed at least 0.7.

[c]/A blank cell indicates that the row scale was not included in the questionnaire for the column activity.

Source is Driver and Cooksey (1980).

Table 3

Percent of Au Sable River (Michigan) Users Who Reported Selected Expected Consequences as Either Extremely or Very Important

	Abbreviated Wording of Expected Consequences	Percent of Respondents Checking the Extremely or Very Important Response
1.	To enjoy the out-of-doors	
	Canoeists & Fishermen	80%
	Residents-Cottage Owners	87
2.	Chance to escape city	
	Canoeists & Fishermen	59
	Residents-Cottage Owners	85
3.	Restful environment	
	Canoeists & Fishermen	79
	Residents-Cottage Owners	73
4.	Enjoy natural surroundings	
	Canoeists & Fishermen	67
	Residents-Cottage Owners	78
5.	Breathe fresh air	
	Canoeists & Fishermen	65
	Residents-Cottage Owners	84
6.	Escape city noise	
	Canoeists & Fishermen	62
	Residents-Cottage Owners	82
7.	Change from the routine	
	Canoeists & Fishermen	65
	Residents-Cottage Owners	73
8.	To feel free	
	Canoeists & Fishermen	54
	Residents-Cottage Owners	64
9.	Be together as family	
	Canoeists & Fishermen	50
	Residents-Cottage Owners	70
10.	Change from busy job	
	Canoeists & Fishermen	45
	Residents-Cottage Owners	67

[1]Responses were to a 9-point response format that ranged from extremely to not at all important. Source is Driver (1976).

Table 4

Rank-Ordered Mean Scores for Top 10 of 40 Items Used in Belle Isle, Michigan Study.

REP	Scale Items	Overall Mean Score 9-point Response Format (N = 300)[1]
1.	Find it relaxing	7.9
2.	Can take it easy	7.3
3.	Get away from hustle and bustle	7.3
4.	Gives my mind a rest	7.1
5.	Is welcome change of pace	7.1
6.	Pleasant change from my job	7.1
7.	Chance to relieve tensions	6.9
8.	Chance to be with friends	6.9
9.	Escape pressures of work	6.7
10.	Get family together for awhile	6.6

1 Score of 9 indicates item was extremely important, and 1 indicates it was not at all important. Source is Davis (1973).

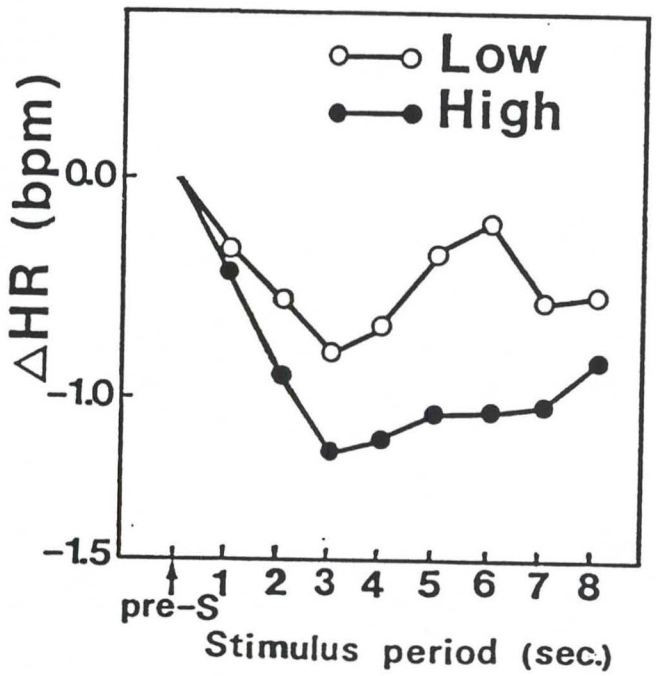

Figure 1. Mean phasic heart rate change expressed in beats per minute (bpm) from the pre-stimulus level for subjects exposed to slides of spatially open landscapes (Higher preference) and spatially restricted environments (lower preference). (From Dimberg and Ulrich, 1989.)

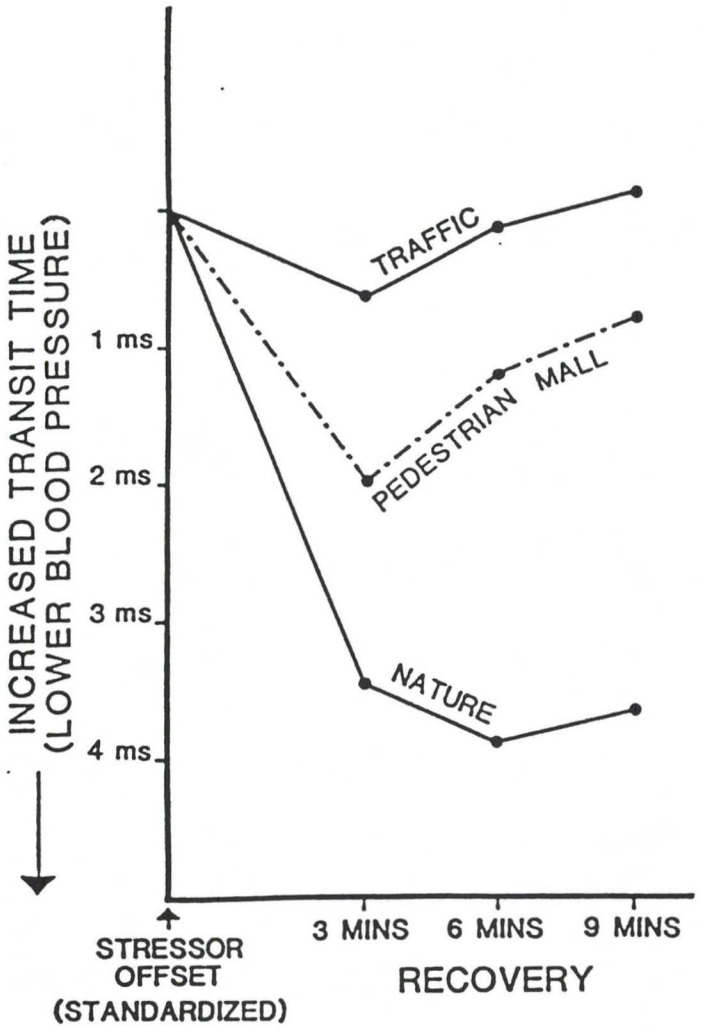

Figure 2. Skin conductance (SCR) during recovery from stress.
(From Ulrich and Simons, 1986.)

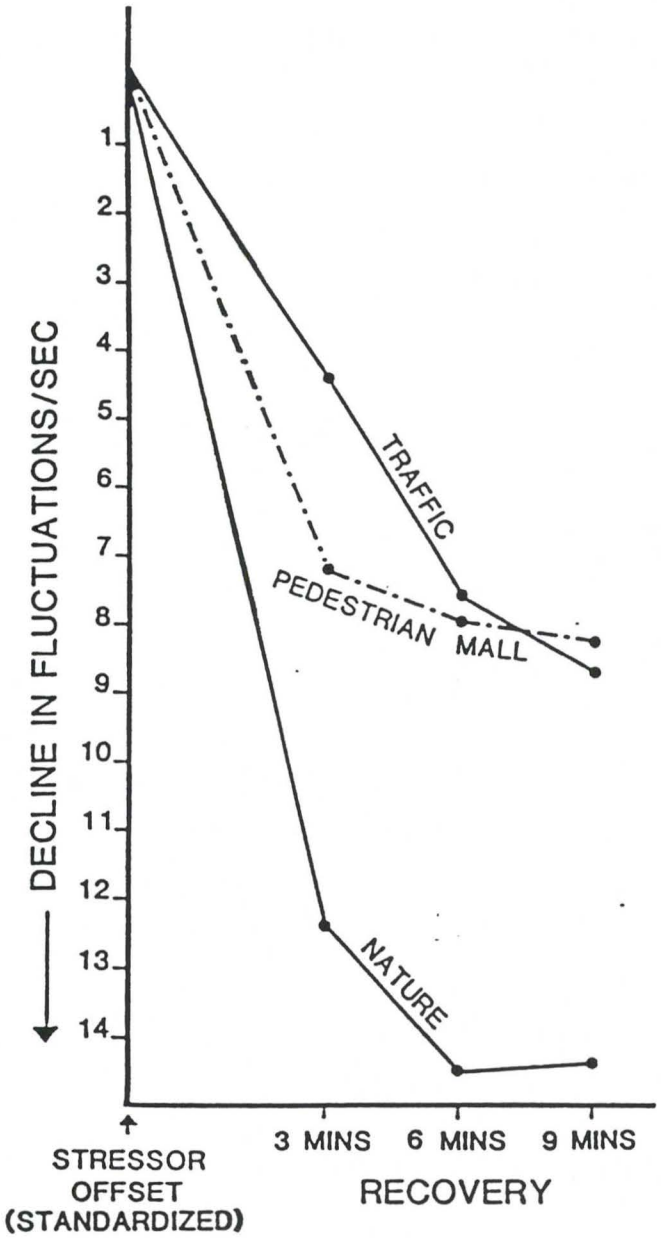

Figure 3. Skin conductance (SCR) during recovery from stress. (From Ulrich and Simons, 1986.)

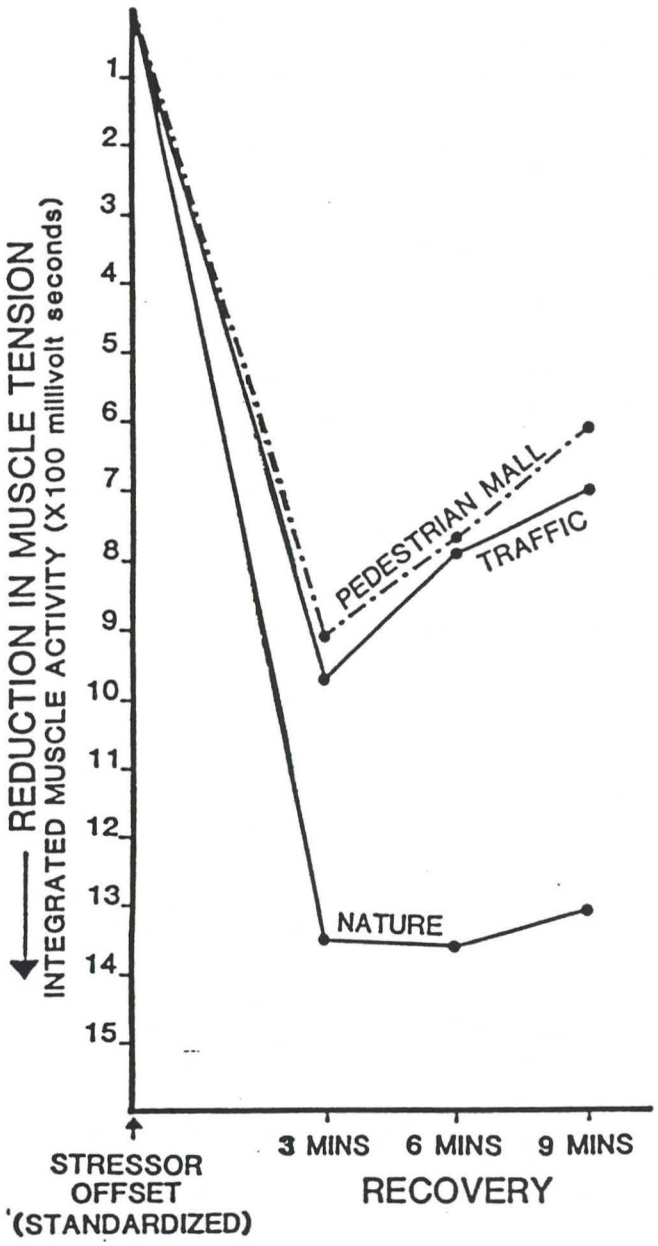

Figure 4. Muscle tension (EMG) during recovery from stress. (From Ulrich and Simons, 1986.)

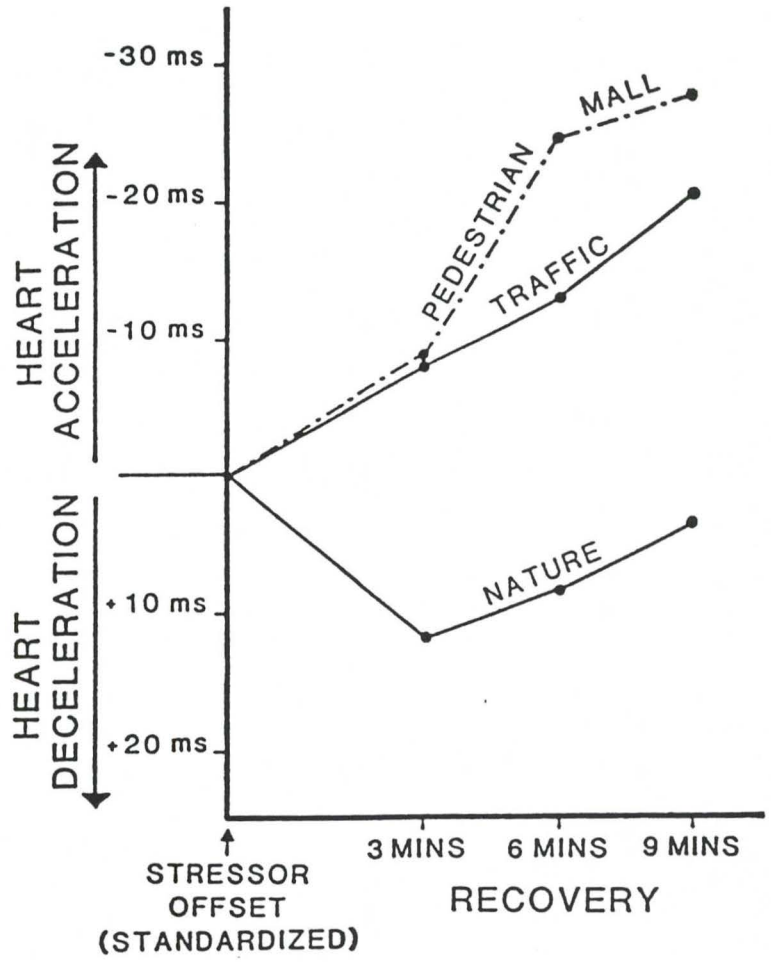

Figure 5. Heart period (HP) during recovery from stress. (From Ulrich et al., 1989.)